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Canada Centre for Mineral and Energy Technology | Centre canadien de la technologie des minéraux et de l'énergie

# CANMET MONTHLY BIBLIOGRAPHY OF CRUSHING AND GRINDING - JANUARY 1980

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# INTRODUCTION

This report presents bibliographical information on the subject of crushing and grinding for January 1980. References were obtained through the CAN/SDI system covering the following data bases:

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| CHEMICAL ABSTRACTS (CA) | 91: 24-26; 1979.<br>92: 2; 1980. |
| COMPENDEX (Engineering Index) | 79: 12; 1980. |
| METADEX (Metal Abstracts) | 79: 11-12; 1980. |
| NTIS (National Technical Information Service of the U.S. Dept of Commerce) | 80: 1-3; 1980. |
| SCIENCE CITATION INDEX | 79: 44-52; 1979. |

The following abstract journals were also searched:

| | |
|---|---|
| CURRENT AWARENESS IN PARTICLE TECHNOLOGY | 13: 1; 1980. |

References are numbered sequentially and are grouped according to the main topics shown below. Not all topics need be presented in any one report.

A) Review articles
B) Crushing
C) Rod and ball mill grinding
D) Autogenous, semi-autogenous and pebble grinding
E) Liners and wear
F) Grinding media
G) Classification
H) Modelling, kinetics and process control
I) Fracture
J) Applications
K) Novel methods

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Review articles

1128. Dolezil, M. and Reznicek, J. "Mineral-processing 1978: a review"; World Min, 32:8:100-111; 1979.

1129. Mihalka, P. "Magnetic-separation: theory, equipment, and application"; World Min, 32:10:105-106; 1979.

1130. Hofmann, F. "Size-reduction: Achema-79 review"; Chem Ing Tech, 51:11:1003-1005; (German); 1979.

1131. Johnson, C. "A review of stonecrushing and grading machinery"; Chem Eng (London), 351:849; 1979.

1132. Giersiepen, G. "Classifiers and sieving devices: Achema-79 review"; Chem Ing Tech, 51:11:1031-1036; (German); 1979.

Crushing

1133. Mulisch, E. "Planning of large primary crushers"; Int Conf on Min Mach, Pts 1 and 2, 79:257-261; 1979.

1134. Wenzel, J.M. "State-of-the-art and development of mobile crushers"; Int Conf on Min Mach, Pts 1 and 2, 79:251-256; 1979.

1135. Anon. "Crushing and conveying aspects of Lengfurst-quarry"; Mine Quarry, 8:10:17-23; 1979.

1136. Peterson, C.R. and Fisk, A.T. "Portable low profile crusher for underground mining applications. Phase 1 design"; US NTIS Rep, PB-298 169, 85 pp.; 1978.

Rod and ball mill grinding

1137. Schooler, L. "Comminution of caribbean bauxites in rod mills"; J Met, 31:12:31; Dec. 1979.

The first unit operation in the production of alumina by the Bayer Process involves grinding bauxite in a caustic soda solution. Since particle size in the bauxite slurry affects further processing and handling abilities, the grinding operation is of prime importance. Grinding and slurrying are generally accomplished by utilization of rod mills. The capability of closed circuit rod mills is determined by feed grindability, energy input, and energy utilization. The theoretical approaches to these subjects are presented. In-plant tests were then conducted which substantiated the validity of the models as applied to Caribbean bauxite grinding. (Au).

1138. Hersey, J.A. and Krycer, I. "Fine grinding and the production of coarse particulates"; Chem Eng (London), 351:837-840; 46 ref.; 1979.

1139. Beke, B. "Phenomena in speed regulated ball-mills"; World Cem Technol, 10:8:303-310; 1979.

The newly introduced thyristor controlled annular motors allow speed regulation of ball mills. Italian and Russian investigations conducted on a commercial scale have established that in a certain range of parameters a smaller filling rate requires a higher speed of rotation. An explanation is given in this contribution. It is shown that the lack in grinding body charge as a consequence of wear can be compensated by a speed increase without a stoppage in operation. (Au).

1140. Cutting, G.W. "The characterization of mineral release during comminution processes"; Chem Eng (London), 351:845-849; 8 ref.; 1979.

1141. Ironman, R. "New grinding-mill design at Cemij, Holland: Sliderings-mill"; Rock Prod, 82:8:68-70; 1979.

1142. Entzmann, Karl "Method and apparatus for activating comminution of minerals"; British patent 2,006, 735; Oct. 13, 1977.

1143. Kanda, Yoshiteru, Gunji, Hiroshi and Mishima, Ikuro "Rate constants of wet and dry ball mill grinding"; Zairyo, 28:312:815-818; (Japanese); 1979.

Autogenous, semi-autogenous and pebble grinding

1144. Prem, H. and Prior, M. "Impact mills for fine size-reduction"; Chem Eng (London), 351:841-844; 1979.

1145. Anon. "Impact-mill for precrushing in a dolomite and lime quarry"; TIZ-Fachber, 103:8:500-501; (German); 1979.

1146. Bohm, J. and Petho, S. "The change of hammer-mill output and the particle-size-distribution of its product by the modification of the grid"; Epitaonyag, 31:10:373-379; (Hungarian); 1979.

Linears and wear

1147. Sitnikov, E.M. and Svekrov, V.M. "Ball-mill lining beams made from rolled products"; Metallurgist, 23:3-4:194-195; 1979.

Grinding media

1148. Tanemura, Tadashi, Iwabuchi, Toshitsugu and Okaue, Hiromitsu "Influence of grinding aid on the properties of cement and compressive strength of concrete"; Semento Gijutsu Nempo, 31:90-92; (Japanese); 1977.

1149. Semba, Kimio and Sugawara, Mituo "On grinding aids for roseki"; Taikabutsu, 258:352-354; (Japanese); 1979.

Classification

1150. Worrell, W.A. and Vesilind, P.A. "Testing and evaluation of air classifier performance"; Resource Recovery and Conservation, 4:3:247-259; 12 ref.; 1979.

This paper introduces a new parameter for describing air classifier performance, "Total Efficiency", found by first calculating the fractions recovered of both light and heavy fractions at specific air speeds and then mulitplying the two fractions. Total Efficiency can be plotted against air speed, and such plots yield information about peak efficiencies and sensitivity to air flow rate variations. This method allows the comparison of different air classifiers and also leads to a technique in which the data can graphically express contamination of the light or heavy fraction at different air speeds. These curves can then be used to determine the optimum air speed in terms of market value of the product produced. Data on three different throat design - the zigzag throat and two variations of the zigzag, are used to illustrate the method. (Au).

1151. Hepburn, D. "Using hydrocyclones in particle recovery"; Processing, 25:12:21-23; 1979.

1152. Murray, Donald L. "Air classifier performance and operating principles"; 8th Proc of Natl Waste Process Conf, Energy Conserv through Waste Util, Chicago Ill, Publ by ASME, New York; May 7-10, 1978.

1153. Birss, R.R. and Dennis, B.J. "Particle capture on the upstream and downstream side of wires in HGMS: high graident magnetic - separator"; IEEE Trans Magn, MAG-15:5:1362-1363; 1979.

1154. Blaszczynski, S. and Olas, A. "Enrichment of fine coal particles in hydrocyclones"; Zesz Nauk Politech Slask Gorm, 88:41-49; Polish; 1979.

1155. Killmeyer, R.P. "A performance study of Baum-jigs and Batac-jigs"; Min Congr J, 65:8:42-46; 1979.

1156. Browning, J.S. "Recovering fine size coal from Alabama underground mine washer wastes using the Hymphreys-spiral"; US NTIS Rep, FE-9005-TI; 14 pp.; 1978.

The Mineral Resources institute and State Mine Experiment Station of The University of Alabama conducted Humphreys spiral tests of fine coal waste from nine preparation plants of Alabama underground mining operations, to determine the feasibility of recoverying low ash and sulfur fuel meeting steam coal specifications. The ash in the samples ranged from 19.0 to 41.9 per cent, and the total sulfur ranged from 0.68 to 1.33 per cent. Continuous laboratory tests using a Humphreys spiral gave good recovery of the coal with excellent rejection of the ash and pyritic sulfur. Coal recoveries of 95.6 to 97.5 per cent were achieved from the different samples. Ash content of the clean coal products fell within a range of 8.1 to 8.7 per cent, with a total sulfur content of 0.81 to 1.29 per cent. In quality, the products were comparable or superior to those now being shipped from the preparation plants. (Au).

1157. Lindbery, T. "Experience with the Jones'-separator at Buchanan: wet high-intensity magnetic-separation"; Min Mag, 141:3:199-207; 1979.

1158. Parsonnage, P. "Extension of range and sensitivity of laboratory isodynamic magnetic-separator"; Trans Inst Min Metall Sect C, 88:182-186; 1979.

Separations of mineralogical samples at sizes down to 10 micron were made with a Frantz isodynamic separator modified to operate in the wet mode. The applicability of the method to the investigation of ores and mill products was assessed and it was shown to be highly effective in the analysis of fine materials, such as flotation products. The use of a heavy-liquid medium can, in certain cases, increase the sensitivity of separation, particularly for very weakly magnetic, low-density phases and for phases with similar magnetic susceptibility but differing densities. The apparatus was calibrated to relate the current setting with the magnetic susceptibility of separation. (Au).

1159. Anon. "An alternative to conventional screening: Mogensen sizer"; Chem Eng (N.Y.), 86:25:109-110; 1979.

For separation of both dry and wet materials, this compact sizer uses a vertical-flow design, reducing operating costs and space requirements. Other advantages include longer screen life and simple installation. (Au).

1160. Fischer, J.A. "Screening leaders: comments on advantages and disadvantages of screening-media"; Pit Quarry, 72:3:55-58; 1979.

1161. Grubbs, M.R. and Coulombe, E.J. "Evaluating rotary-drum air-classification of shredded solid waste"; Conserv Recycl, 3:1:45-51; 1979.

1162. Miranda, P.M. "Scalping, screening, sizing: all handled efficiently by wire cloth screens"; Rock Prod, 82:7:78-82; 1979.

1163. Muzyka, D. and Beeckmans, J.M. "Effect of convective velocity on longitudinal diffusivities in a fluidized cascade-separator"; Can J Chem Eng, 57:5:586-590; 1979.

1164. Liller, Delbert I. "Coal washing plant employing a feed equalizer and a critically dimensioned deflector surface in the inlet pipes of a plurality of cyclones"; U.S. Patent 4, 164, 467; Dec. 14; 1977.

1165. Maletskii, Yu. M., Bandaevskii, G.I. and Matveeva, T.A. "Experimental vibrating screen for washing and leaching impurities from sodium chloride"; Khimiya I Tekhnol Mieral'n Solei I Galurgichesk Pr-v Barn Aul, 97-100; (Russian); 1978.

1166. Sinel'nikov, N.V. and Korablev, N.M. "Determination of the efficiency of air classifier for luminophors"; Texisy Dolk Vses Soveshch "Technol Protsessy Appar Kach Prom Lyuminoforos", 101-102; 1977.

1167. Kosoi, G.M. "Energy losses during separation of multiphase systems in hydrocyclones"; Theor Found Chem Eng, 12:6:725-731; Nov.-Dec. 1978.

1168. Schaller, R.E., Auw. P.K. and Dunbar, R.M. "Performance characteristics of a laboratory multiple rotor particle size classifier"; J Powder bul Solids Technol, 2:3:39-45; 9 ref.; 1978.

Modelling, kinetics and process control

1169. Hilger, M. and Keviczky, L. "Model analysis and flow rate control for closed circuit mills in cement industry"; Zem Kalk Gips, 32:10:499-503; 1979.

The article describes theoretical conceptions which can help to establish and develop a control engineering model of a grinding mill. The static and dynamic conditions of a closed-circuit grinding plant with end-discharge ball mill are considered. The possibilitites of flow rate control by means of microprocessors are also discussed. (Au).

1170. Rajamani, K. "Optimal control of closed-circuit ball mill grinding"; Thesis 791219, (Diss Abs Int 1852B), 317 pp.; 1979.

1171. Heiskanen, K. "On the estimation of system parameters in mathematical simulation of batch grinding"; Dissertation no. 412, Helsinki University of Technology Otaniemi (Finland); 157 pp.; 1978.

1172. Nichols, Frank P. "Process quality control in the crushed-stone industry"; Transp Res Board Transp Res Rec, 691:4-7; 4 ref.; 1978.

1173. Hatch, C.C. and Mular, A.L. "Simulation of the Brenda Mines Ltd. secondary crushing plant"; Soc Min Eng, Caller No. D, Littleton, Colo.; 12 pp.; 1979.

1174. Kawatra, S.K. and Thayer, D.M. "Particle-size control in a wet grinding circuit"; 16th Application of Computers and Operations Research in the Mineral Industry Symp, Tueson, Az; Chapter 56, 595-603; Oct. 17-19, 1979.

For efficient control of particle size in a wet grinding circuit, three alternative methods for monitoring product particle size are available. These methods are based on:

1. Ultrasonic wave absorption.
2. Low-angle forward scattering of a laser beam.
3. Inferential sizing techniques.

The relative advantages and disadvantages of each technique are discussed.

A particle size monitor can be used on a single grinding line to control the product particle size. To minimize the number of particle size monitors at an operation consisting of many similar grinding lines, a portable multi-stream on-line analyzer can be used. The paper outlines the design and the operational characteristics of the portable multi-stream on-line analyzer. (Au).

1175. Watts, J.C., White, J.W. and Hallin, L.D. "Problems and solutions in the control of ball mill circuits"; 16th Application of Computers and Operations Research in the Mineral Industry Symp, Tucson, Ax; Chapter 53, 560-578; Oct. 17-19, 1979.

Ball mill grinding circuit control has received increasing emphasis in the past few years due to such factors as declining ore grades, increasing production costs, and advances in analytical devices and minicomputer technology. Since ball mill circuits have been a traditional bottleneck in mineral processing plant throughput, control systems often improve throughput without requiring additional processing equipment. In addition, much of the variability of the grinding product size and consistency is often removed, allowing better process operation downstream. Among the problems which arise in designing and implementing a process control strategy for ball mill circuits are circuit constraints imposed by processing equipment and local management, proper instrument selection, installation and maintenance, and use of calculated or inferred variables for process measurements. This paper discusses these problems and attempts to identify valid approaches to their solution. (Au).

1176. Birss, R.R. and Parker, M.R. "Modelling of fields in magnetic-drum-separators"; TEEE Trans Magn MAG-15:5:1305-1309; 1979.

Little analytical work has been done in evaluating the periodic magnetic fields and associated field gradients which determine periodic magnetic fields and associated field gradients which determine small particle behaviour in drum separator systems. One of the few investigations of recent times is that of W.F. Brown, Jr. (1) in which experimental data on field values are fitted to a Fourier series expressed in terms of the aximuthal angle about the drum axis. Here, a simple Fourier series for linear periodic filed arrays is adapted to the cylindrical geometry of drum separators, enabling for the first time, the construction of satisfactory equations of motion for small magnetic particles in such systems. (Au).

1177. Svallonas, V. "Some considerations in computer structural analysis of large grinding mill shells"; Soc Min Eng, Caller No. D, Littleton, Colo.; 16 pp.; 1979.

1178. Goll, G. et al. "Investigations of the comminution of particle assemblies under predominant impact stress"; Aufbereit Tech, 21:5:231-237; (German); 1980.

Results on the comminution characteristics of packings of glass spheres and irregularly shaped particles under predominant impact stress are reported. The test results are described in terms of selection and breakage functions, indicating that the mathematical description of the breakage probability distribution differs from that for single-particle comminution. In addition, the breakage probability for particle assemblies shows a dependence on particle size, material, and structure. The experimental investigations are supplemented by photographs. The latter confirm that a substantial portion of the stress energy is lost through rearrangement processes within the assembly of particles or is converted into kinetic energy of the ejected fragments at the expense of the comminution process. Further investigations indicate that the present results are also applicable for other stress velocities. (Au).

Applications

1179. Pazour, D.A. "Cyprus anvil: largest mine in the Yukon Territory"; World Min, 32:7:40-45; July 1979.

1180. Singh, S.P.N. and Peterson, G.R. "Survey and evaluation of current and potential coal beneficiation processes"; Oak Ridge Natl Lab Rep, ORNL/TM-5953, 310 pp., 1979.

1181. Skolni,, E. and Shallenberger, H.J. "Coal and coal preparation: a brief introduction"; Instrum Min Metall Ind, 6:71-90; 1978.

1182. Supp, A. and Brandhoff, W. "Peripheral-discharge-mills sole grinding problem"; World Min, 32:10:90-98; 1979.

1183. Raub, A.B. "The latest design criteria for a small copper concentrator. The Oracle Ridge project"; Soc Min Eng, Littleton Colo, Caller No. D; 7 pp.; 1979.

1184. Mullov, V.M. and Lodeishchikov, V.V. "Experience of using planetary mills for working sulfide raw material"; izv Sib Dtd Akd Nauk SSSR Ser Khim Nauk, 3:71-73; (Russian); 1979.

1185. Bystrikov, A.V. and Butyagin, P.Yu. "Chemisorption of oxygen during grinding of quartz"; 2nd Tezisy Dolk Vses Simp Skk Poverknm Tverd Tel, 80-81; (Russian); 1977.

Novel methods

1186. Anon. "Semi mobile-crushing-plants display novel design"; Pit Quarry, 72:3:60-63; 1979.